

changes in jaw and radular structures. The change is partial in the south-east Napier Range, complete in the taxa living west of Windjana Gorge. *Westraltrachia* shows partial pre-adaptation for this shift. In sympatry with *Amplirhagada* under conditions of increased abundance of algal-films, it has diverged in feeding structure and resource use.

Conchological convergences involve first reduction, then loss of color pattern in the south-east, size change in the central area, then evolution of chalk-white shells that are almost identical in size and shape in the north-west Napiers. The new convergent morphotype is different from both ancestral models. There is no evidence of unusual predation pressure to explain why this massive shell convergence occurred.

**SHELL MORPHOLOGICAL VARIATION IN PUPILLA (PULMONATA: PUPILLIDAE).** Peter B. LaRochelle, University of Colorado Museum, Boulder.

The taxonomy of the genus *Pupilla* is based entirely on shell characters: compliment of teeth (lamellae, folds, plicae, etc.), shell dimensions, number of whorls, and other calcifications within and behind the peristome. Pilsbry (1948) recognized six North American species, namely *P. sonorana*, *P. blandi*, *P. muscorum*, *P. hebes*, *P. syngenes*, and *P. sterkiana* of which the first five are closely allied. *P. blandi*, *P. muscorum*, and *P. hebes* have been reported from Colorado.

More than 100 lots of Colorado *Pupilla* were examined comprising over 600 specimens. Adult tooth number is highly variable between and within lots and can range from zero to three within a single lot. Similarly, the crest behind the peristome may be absent to well formed. There appears to be no strong relationship between tooth number and either shell height, shell diameter, number of whorls, or crest formation.

The distribution of the various dental forms of *Pupilla* in Colorado was determined. The three toothed form (*P. blandi*) is found both east and west of the continental divide and is the predominant form on the western slope. Poorly dentate forms (*P. muscorum* and *P. hebes*) are found primarily east of the continental divide along the front range of the Rocky Mountains with only occasional specimens being found on the western slope.

In light of the wide variability in certain shell characteristics of *Pupilla* in Colorado and the poor relationship between tooth number and other shell features, I hypothesize that *P. blandi*, *P. muscorum*, and *P. hebes* are variations of a single species, *Pupilla muscorum*. Variables such as climate, soil mineral content, predation, and the nature of dispersal events may influence the frequency of the various shell forms exhibited by this species.

**DISCOVERY OF RECENT HENDERSONIA OCCULTA (SAY) IN MISSOURI.** William Hay, Jefferson City, Missouri.

*Hendersonia occulta* (Say) was abundantly and widely distributed during the Pleistocene and is commonly found in loess deposits in Missouri. Its present distribution is rather disjunct and widely separated localities have been reported from Pennsylvania, North Carolina, Virginia, Ten-

nessee, Illinois, Wisconsin, Minnesota, and Iowa. This report represents the first recent specimen of *H. occulta* recorded from Missouri.

**ENVIRONMENTAL RECONSTRUCTION OF THE HOLOCENE OF THE TEXAS PANHANDLE: 10,000 YEARS OF TERRESTRIAL AND FRESHWATER GASTROPODS.**

Raymond W. Neck, Texas Parks and Wildlife Department, Austin.

The Eastern Caprock Escarpment presently contains a gastropod fauna characterized by low species diversity communities that are restricted to isolated patches of favorable microhabitats. Sequential sediments from 10,000 B.P. to the present from the Lake Theo Site have allowed an analysis of a gastropod fauna that has been reduced substantially by local extinction. The extirpation process appears to have been a three stage process. Snails suffering extinction at approximately the same time are generally from the same general geographical area. Extirpated species include those now occurring in more eastern areas and those now restricted to areas to the north. Snails present in the oldest levels could exist at the Lake Theo Site with a more equable regime of precipitation and an amelioration of summer temperature extremes. Denser deciduous woodlands probably occurred over larger areas than occur today. Older sediments indicate presence of mesic to saturated soils in these woodlands. An intensive survey of the area surrounding the Lake Theo Site has revealed a depauperate modern snail fauna of low diversity.

**LATE QUATERNARY LAND SNAILS FROM THE NORTH COAST OF JAMAICA.** Glenn A. Goodfriend, Department of Zoology, University of Florida, Gainesville.

The historical biogeography of Jamaican land snails is examined, based on four late Quaternary deposits from small solution holes at the Green Grotto Caves on the central north coast of the island. Amino acid racemization/epimerization dating (based on alloisoleucine/isoleucine ratios) indicates that the oldest deposit probably dates from the glacial period before last. Two deposits are of Wisconsinian age and the fourth is of late Holocene age (< 3000 yr). Evidence is presented that Pleistocene conditions at the site were cooler and drier than at present.

A number of species (including north coast endemics as well as currently widespread species) occur in all four deposits and are still living at the site. These species appear to have persisted at this locality through the late Pleistocene and Holocene. Other species in the deposits no longer live at the site or surrounding areas. For example, five species that occur only in the Pleistocene deposits are currently limited to the cooler and moister interior plateau. The extension of the ranges of these species down to the coast during the Pleistocene is probably associated with the cooler temperatures of that time. *Urocoptis brevis*, now limited to the dry south coast and the driest part of the north coast (some 25 km west of the site), occurs in one Pleistocene deposit. The eastward extension of its range at that time may be associated with the drier

climatic conditions. *Sagda montegoensis*, abundant in the Pleistocene deposits, is now endemic to a small area at the western end of the island. This change in distribution does not seem to be associated with climatic changes.

Thus the late Quaternary is seen to have been host to

some large changes in the geographical distributions of many land snails along the north coast of Jamaica. As in the temperate zone during that time, there was no shifting of faunas *en mass* but instead, different species were affected in different ways.

### ABSTRACTS POSTER SESSION

Arranged by Clement Lee Counts, III  
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**CHRONOLOGY OF THE INVASION OF NORTH AMERICA BY CORBICULA FLUMINEA (BIVALVIA: CORBICULIDAE).** Clement L. Counts, III, College of Marine Studies, University of Delaware, Lewes.

Zoogeographic records of the exotic Asiatic clam *Corbicula fluminea* (Müller, 1774), from the malacological collections of twenty-three museums in the United States, were examined with respect to localities of occurrence and dates of collection. Similar information was gathered from state natural resources departments and published accounts of *C. fluminea* in the United States. All data were combined and then segregated into yearly summaries. Zoogeographic distribution maps were plotted for *C. fluminea* for the time intervals ca. 1925-1945, 1946-1955, 1956-1960, 1961-1965, 1966-1970, 1971-1975, 1976-1982. The zoogeography of *C. fluminea* in the United States through time is related to human transport and theories of animal transport do not account for its present or historic distribution.

**ONTOGENETIC SHELL AND RADULAR CHANGES IN THE DENTALIID SCAPHOPOD, GRAPTACME CALAMUS (DALL, 1899).** Paul S. Mikkelsen, Harbor Branch Foundation, Inc. Ft. Pierce, and Kathryn Muldoon-McLaughlin, Applied Biology, Inc., Jensen Beach, Florida.

Specimens of *Graptacme calamus* (Dall, 1899), collected from offshore of the central east coast of Florida, were examined for details concerning ontogenetic changes in shell length, diameter, sculpture and fractionation. Although the species is known to form an apical plug following breakage of the shell, specimens were determined to fracture at particular, possibly predetermined points, at regular intervals. Shell sculpture changed from smooth to minutely ribbed at a length of about 1.5 mm. The rachidian tooth of juveniles possesses a central prominence which flattens and broadens with age of the specimen, to attain the flat appearance characteristic of the adult rachidian. The number of radular rows increased ontogenetically.